

**AN ASSESSMENT OF THE LEVEL OF ADOPTION OF DISRUPTIVE
TECHNOLOGIES IN ACADEMIC LIBRARIES IN KENYA: A CASE STUDY OF THE
MAHATMA GANDHI GRADUATE RESEARCH LIBRARY, UNIVERSITY OF
NAIROBI, KENYA.**

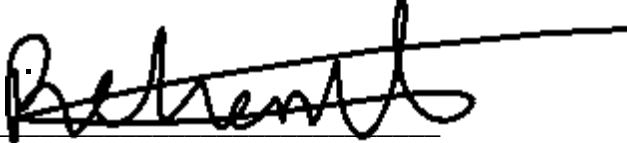
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**A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF LIBRARY
AND INFORMATION SCIENCE, DEPARTMENT OF LIBRARY AND INFORMATION
SCIENCE, UNIVERSITY OF NAIROBI.**

NOVEMBER 2021

DECLARATION

This research project work is my original work and has not been submitted for examination to any other university.

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This research project has been submitted for examination with our approval as the university supervisors.

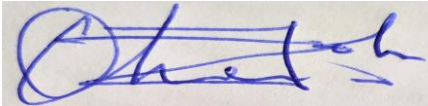
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DEDICATION

With total respect and appreciations, I fully dedicate this research project work to my dear spouse Veronica Mumbua and to my children Linus and Fridah Nzuki, who have always been a source of inspiration and psychological support through prayers and encouragement during the high demanding and challenging moments that resulted in this work.

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I thank our Almighty God for the care, provision, guidance, and protection. Secondly, I express my special gratitude and appreciation to my supervisors Dr. Dorothy Njiraine and Dr. John Oredo, who despite their heavy workload, they endeavored to give me the necessary guidance and support throughout this research project.

Lastly, I acknowledge the assistance and contributions I received from the Mahatma Gandhi Graduate Research library staff, ICT staff and University of Nairobi library management during the data collection exercise.

ABSTRACT

Academic libraries across the globe are vital entities based at the heart of universities to support knowledge production, information resources sharing and dissemination to meet the educational, research and teaching needs. Most libraries have for long adopted the use of ICTs in their operation and provision of library services. However, the frequent evolution and the disruptive nature of these technologies has continued to transform and disrupt the entire information management ecosystem in which academic libraries fall in. The study aimed at assessing the level of adoption of disruptive technologies in academic libraries with reference to the Mahatma Gandhi Graduate Research Library, University of Nairobi. The study was guided by the following objectives: to establish the library staff perceptions on the use of available disruptive technologies; to establish the extent of adoption of disruptive technologies at this library; to find out the library staff capacities in the use disruptive technologies; to examine ICT infrastructure supporting adoption of disruptive technologies at the library; to propose appropriate strategies for the adoption and utilization of disruptive technologies in academic libraries in Kenya. The study used the qualitative research design and purposive sampling technique where a sample size of 11 respondents consisting of the library staff, University of Nairobi library management, and ICT staff was selected. Due to the global Covid-19 pandemic which prevented physical meetings, interview guides were administered to all respondents through telephone calls, video conferencing. Qualitative research approach was applied to analyze, interpret, and discuss data collected through interview guides. The findings from the research showed that: Library staff perceptions were positive on the use of disruptive technologies. The library has adopted and uses some of the available disruptive technologies although it has not adopted the newer technologies in the market. Majority of the library staff were competent, well trained, and skilled on the use of the disruptive technologies adopted at this library although not all the technologies adopted were fully utilized. The library has put in place an ICT infrastructure to support adoption of disruptive technologies, however it can not support newer technologies. In conclusion, it was noted that adequate financial resources were needed to support adoption of newer technologies and train staff. Carry out more benchmarking activities overseas on new technologies as well as employ more ICT staff.

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LIST OF ABBREVIATIONS AND ACRONYMES

AI:	Artificial intelligence
e-Books:	Electronic books
e- Resources:	Electronic resources
ICTs:	Information and Communication Technologies
IFLA:	International Federation of Library Associations and Institutions
IoT:	Internet of things
IR:	Institutional Repositories
LAN:	Local Area Networks
MGGRL:	Mahatma Gandhi Graduate Research Library
OPAC:	Online Public Access Catalogue
VR:	Virtual reality

CHAPTER ONE

INTRODUCTION

1.0. Background of the Study

Academic libraries across the globe are vital entities based at the heart of universities and other institutions of higher learning to support knowledge production, information resources sharing and dissemination to meet the educational, research and teaching needs of their users. Academic libraries have for long adopted digital information technologies in their operations and delivery of library services to their users. However, frequent evolution and the disruptive nature of these information and communication technologies (ICTs) has continued to transform and disrupt the entire information management ecosystem in which academic libraries fall in.

Disruptive technology is defined as an innovation which creates a new market or value network and eventually goes on to disrupt an existing market (Evans, 2013:5). Its further defined by International Finance Corporation, (2019:16) as those technologies that result in a significant change in the cost of, or access to, products or services, or that dramatically change how we gather information, make products, or interact.

Cooper, (2015:1) states that the library industry is within the information management ecosystem that have been disrupted by technological innovations. Most academic libraries have been compelled to adopt interactive information tools such as online information portals and systems for their survival mainly because of their profound influence on the library functions as well as the information seeking behavior of users. According to Bradley, (2019:1), adoption of disruptive technologies by libraries helps librarians in their work, reduce manual library operations, support inclusive and accessible library services, promote collaboration among people leading to more information sharing and communication as well as facilitation of new research discoveries.

World Economic Forum, (2017:1) opines that, some of the disruptive technologies transforming the entire library information management ecosystem include digital media store (from compact disc (CD) to iTunes), streaming video portals, smartphones, 3D printing, collaborative consumption, drones, cloud computing and robots among others. Therefore, as stated by

Abdullah et al., (2018:1), these technologies have continued to influence the way information and knowledge is being created, utilized, stored, managed, transferred, and shared by libraries, authors, and publishers.

From a global perspective, these innovative technologies bring the promise of improved performances in libraries (IFLA, 2016:2). For instance, academic libraries in developed world like the America's have adopted and implemented disruptive technologies such as chatbots and Amazon's Alexa to help their library users find more relevant literature and more quickly (Bradley, 2019:3). Similarly, through streaming services, West Vancouver libraries offer customers access to Netflix while State Library of Queensland offers free access to 30,000 films (John, 2020:1).

In European countries, Cotera, (2018:4) opines that, open libraries in Scandinavia have adopted RFID technologies, and cloud printing, copying, and scanning services in delivery of information services and library operations. This author goes ahead to state that IE University in Spain has developed a mobile app named "My IE Library APP" which library users use to access library electronic resources.

In far East and South Asia, robots are being used by libraries with huge collections for inventory purposes in Singapore. For instance, Temasek Polytechnic Library uses the 'Robbie' robot to scan books. This library has also developed the "Ask Library Chatbot" that helps library users to get quick and instant answers to their frequently asked questions about library (Temasek Polytechnic Library, 2020:1). In China, the Shanghai library has developed an interactive website where library users can earlier chat with the librarians. Also, due to its huge size, the library has adopted a highly efficient book transportation system called Tele-lift to handle the huge volume of books per day (Shanghai library, 2020:1).

In recent years, there have been technological advancements in library operations in African countries. Some academic libraries have started using systems such as book self-check systems, biometric systems, institutional repositories, electronic acquisitions, online cataloguing, online circulation, OPAC systems, e-journals and e-books are now common. For instance, Chew & Chitumbo, (2018:2) established that an innovation-driven library and information service delivery approach has been implemented at University of Zambia Library hence transforming traditional library services to modern library services. In South Africa, University of Pretoria

provides its library users and students access to some of the latest and most current technology trends through MakerSpace (University of Pretoria, 2020:1). Odeyemi, (2019:5) further established that most Nigerian academic institutions and their libraries offer online information resources and library services to their library users. University of Rwanda library has developed the LibHub which is a single search interface that enables library users to search for all e-resources (University of Rwanda, 2020:1).

In Kenya, most academic libraries have adopted technological innovations in their operations and provision of information resources and services. Studies by Waithaka, (2013:114), Okongo, (2014:53) and Makori, (2017:4) reveals that, most academic libraries in Kenya use digital technologies to offer various dynamic information resources and services to their library users. Kenya National Library Services although a public library, it also offers academic resources to its users and it has deployed disruptive technologies such as social media (YouTube channel, Facebook page, LinkedIn, twitter) and online service such as library catalogue (OPAC), e-resources among others (Kenya National Library Service, 2020:1).

1.1.1. Context of the Study

Mahatma Gandhi Graduate Research Library is one of the branch libraries of the University of Nairobi and is located at the main campus (University of Nairobi, 2021). The ultra-modern library with a sitting capacity of 500 was opened in 2019. It's equipped with state-of-the-art technologies and strives to provide quality library services and information to postgraduate students at the master's and doctoral levels as well as academic staff.

1.1.3. University of Nairobi library system organization structure

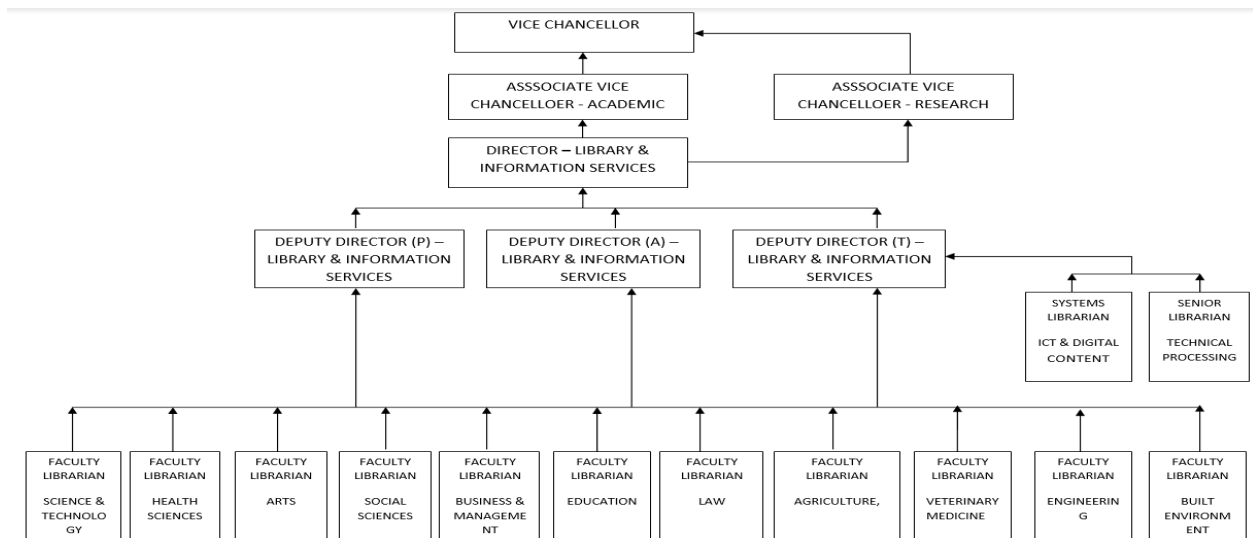


Figure 1: Source: University of Nairobi, (2021)

The top management includes: The Director library and Information services managing the entire University of Nairobi library system including its branches. Three Deputy Directors, one in-charge of planning, another in-charge of administration and the third in-charge of technical services. The middle management consists of faculty librarians, senior librarian technical processing and systems librarian. The lower cadre in the operational level include senior library assistants and library assistants.

1.2. Statement of the Problem

For long, most libraries have been compelled to adopt information and communication technologies for their survival mainly because of their profound influence on the library functions and information seeking behavior of users. However, the tectonic shifts and a remarkable upsurge in the adoption of disruptive technologies in libraries globally as well as library users' behaviors continues to transform the way library information resources and services are offered. According to Wilders, (2017:1), most academic libraries have transformed into open shelf environments which have replaced some of the manual library services operations. Additionally, Shea-Tinn & Zhiping (2016:1) found out that, in recent years, the increasing emergence internet-related innovations in the field of library and information environment has seen faculty and students gradually moving away from their physical libraries. However, the above studies were viewpoints and do not indicate any fieldwork was carried out to assess the level of adoption of disruptive technologies in libraries in Kenya.

Many academic libraries across the globe face a lot of challenges while adopting disruptive technologies. Muriithi et al., (2016:4) posits that the effects of technological disruptions, financial recess, inadequate ICT infrastructure, inadequate skills, and continuous budget cuts are some of the challenges that hinder adoption of technologies in libraries. However, the above study was aimed at identifying the challenges and factors that hinder the use of ICTs in support of collaborative research among learning institutions in Kenya and was not aimed at studying the level of adoption of disruptive technologies in libraries hence the need to carry out the study.

Additionally, the ever-changing landscape of disruptive technologies is putting information organization and libraries at crossroads hence cause confusion on the right and appropriate systems to adopt (Makori, 2017:4). Similarly, Muriithi et al., (2016:12) found out that inadequate awareness among library information professionals about the diverse range of disruptive technologies available in the market and the available options is causing more confusion. However, these two studies above were also viewpoints as they do not show any fieldwork was done in Kenya. Similarly, Mahatma Gandhi Graduate Research Library was not in existence by the time they were published hence the need to carry out a study.

Inadequate management support by the parent institutions' management especially on funding to acquire modern technologies is forcing some academic libraries not to adopt these disruptive technologies which require adequate financial resources to adopt and maintain. For instance, a study by Zeleza, (2019:2) established that, much attention for most universities in African countries focuses on curricula reforms aimed at preparing students holistically for the skills of both today and tomorrow yet give little attention to adoption of fourth industrial revolution technologies in academic libraries for education and knowledge sharing. This inadequate attention and support from the university management leaves academic libraries struggling with many challenges which leads them to become irrelevant to their users. However, this study cannot be assumed to be the true case for all academic libraries especially in Kenya. It is in this regard, the study sort to assess the level of adoption of disruptive technologies in academic libraries in Kenya with reference to Mahatma Gandhi Graduate research library, university of Nairobi, Kenya.

1.3. Aim of the Study

The purpose of this study was to assess the level of adoption of disruptive technologies in academic libraries in Kenya with particular reference to the Mahatma Gandhi Graduate Research Library, University of Nairobi.

1.3.1. Objectives of the Study

The objectives of this study were to:

- 1) Establish the library staff perceptions on the use of available disruptive technologies at MGGRL.
- 2) Establish the extent of adoption of disruptive technologies at MGGRL.
- 3) Find out the capacities of library staff in the use disruptive technologies.
- 4) Examine the ICT infrastructure supporting adoption of disruptive technologies at MGGRL.
- 5) Propose appropriate strategies for the adoption and utilization of disruptive technologies in academic libraries.

1.3.2. Research Questions

- 1) What are the library staff perceptions on the adoption and use of disruptive technologies at MGGRL?
- 2) To what extent has disruptive technologies been adopted at MGGRL?
- 3) To what extent are library staff able to use disruptive technologies at MGGRL?
- 4) How frequent are MGGRL library staff trained to keep up with the disruptive technologies' trends?
- 5) What is the level of funding allocated to support adoption and utilization of disruptive technologies at MGGRL?
- 6) What ICT infrastructure has been put in place at MGGRL to support adoption and utilization of disruptive technologies?
- 7) What is the ideal ICT environment for adoption of disruptive technologies at MGGRL?
- 8) What challenges are faced by MGGRL library staff in the adoption of disruptive technologies?
- 9) Do you have solutions to the above challenges?
- 10) What are some of the appropriate strategies you can propose for the adoption of disruptive technologies in academic libraries?

1.4. Significance of the Study

The research findings of this study act as a feedback tool to University of Nairobi's Mahatma Gandhi Graduate Research Library administration as it highlights the various disruptive technologies that the library can consider adopting. Additionally, this study provides a strategic direction and new insights to all University of Nairobi library stakeholders and policy makers in addressing adoption of disruptive technologies and their sustainability. This study also contributes to the existing body of knowledge related to adoption and utilization of disruptive technologies in libraries as well as form a basis for further research on this area of study.

1.5. Justification of the Study

Disruptive technologies hold enormous potential for libraries and most academic libraries have been compelled to adopt disruptive technologies for their survival mainly because of their profound influence on the library functions as well as the information seeking behavior of users. Therefore, it's important for academic library staff in developing countries to embrace the use of disruptive technologies in provision of library resources and services. Academic library staff in developing countries cannot overlook the impact of these disruptive technologies as it relates to access and utilization of academic and research information resources hence the need for this study.

Additionally, disruptive technologies are being used in most libraries which enables library users to access and share current information resources and services from anywhere anytime through their mobile phones, Tablet, Laptops and desktop computers. Academic library staff in developing countries are expected to make use of the available disruptive technologies to offer library resources and services hence the need to carry out this study to assess the level of adoption of these disruptive technologies in academic libraries.

1.6. Scope of the Study

The study solely centered on studying disruptive technologies being used or applied in libraries and information ecosystem. In view of that, the study focused on assessing the level of adoption of disruptive technologies at Mahatma Gandhi Graduate Research Library, University of Nairobi, Kenya since it's a newly established library within the University of Nairobi library system and deemed to be using new technologies.

1.7. Limitations of the Study

The scope of this study was limited to Mahatma Gandhi Graduate Research Library, and this prevented the researcher from gathering comprehensive data about the topic from various University academic libraries in Kenya. Similarly, the study limited itself to only disruptive technologies related to library and information management ecosystem.

The limitations were compounded by the COVID-19 pandemic that prevented person to person physical meetings as well as suspension of physical teaching in institutions of higher learning. This affected data collection tools that would have been used to collect data hence limiting to use of interview schedule/guides which were administered through phone call and use of video conferencing platforms which required access to internet and time hence costly to respondents.

1.8. Definitions of Operational Terms

Disruptive technologies: technologies that result in a significant change in the cost of, or access to, products or services, or that dramatically change how we gather information, make products, or interact.

Academic library: A phrase used to describe a library established and maintained by a higher institution of learning, including colleges, universities, and other post-secondary learning institutions.

Robot: a robot is a machine which can carry out a complex series of actions automatically based on a computer program.

Robotics: A subset discipline of artificial intelligence which found applications in almost all areas like industries, hospitals, banks, academic institutions, and military operations etc.

1.9. Chapter Summary

This chapter intensively discussed the background information of the study, statement of the problem, aim and objectives of the study and scope of the study. Further to this, the significance and justification of the study were also highlighted.

CHAPTER TWO

LITEATURE REVIEW

2.0. Introduction

This chapter presents the existing body of knowledge related to adoption of disruptive technologies in libraries. Main sources of the literature reviewed were journal articles and other authoritative information sources related to adoption of disruptive technologies in libraries.

The chapter starts with the definition of disruptive technology, the disruptive technologies used in libraries; library staff perceptions towards disruptive technologies, skills and competencies required; ICT infrastructure, and the ideal environment for adoption. Finally, this chapter presents a conceptual frame that guides this study.

2.1. Definitions of Disruptive Technology

According to Evans, (2013:5), the concept of disruptive technology, was invented by Clayton Christensen who defined it as an innovation which creates a new market or value network and eventually goes on to disrupt an existing market or network. This phenomenon has long existed with important relatable examples being the invention of automobile displacing the ancient

horse-driven wagons. Evolution of these technologies have been adopted by many countries to help their organizations and entire economy be on the edge of competing markets. International Finance Corporation, (2019:16) further defines these technologies as those result in a significant change in the cost of, or access to, products or services, or that dramatically change how we gather information, make products, or interact.

Cooper, (2015:1) states that the library industry is within the information management ecosystem that have been disrupted by technological innovations. Most academic libraries have been compelled to adopt interactive information tools such as online information portals and systems for their survival mainly because of their profound influence on the library functions as well as the information seeking behavior of users. According to Bradley, (2019:1), adoption of disruptive technologies by libraries helps librarians in their work, reduce manual library operations, support inclusive and accessible library services, promote collaboration among people leading to more information sharing and communication as well as facilitation of new research discoveries.

2.2. Library Staff Perceptions Towards Disruptive Technologies

Librarians and other information professionals are today faced with rapid disruptive technological developments in all areas of the library and information ecosystem. This calls for them to embrace these disruptive technologies and avoid negative perceptions towards these new technologies. Yeh & Walter, (2016:8) discourages librarians from viewing library technological innovations as a distraction or citing lack of resources as excuses preventing them from adopting these disruptive technologies.

However, there are diverse perceptions on adoption of disruptive technologies. Its important to recognize that different librarians and information professionals from different institutions may lack consensus on the adoption of the available technologies. For instance, Zheng, (2019:1) found out that depending on specific working environment, age and terms of employment, there is fear among librarians on job security and reliability of these robots.

2.3. Adoption of Disruptive Technologies

Library and information management current technological landscape is changing how libraries acquire, process, organize and disseminate information resources and services. According to Wilders, (2017:1), most academic libraries have transformed into open shelf environments which have replaced some of the manual library services operations. Some academic libraries have started using systems such as book self-check systems, biometric systems, institutional repositories, electronic acquisitions, online cataloguing, online circulation, OPAC systems, e-journals and e-books are now common.

With continuous emergence of more disruptive technologies in the library and information ecosystem, some libraries and librarians are now embracing the use of robots and artificial intelligence in their library services and operations (Vlachos et al., 2019:1). Additionally, Amy et al., (2015:1) further established that, some academic libraries are using markerspace, OPAC, google analytics, code academy, schema, omeka 2, smartLibrary, libGuides among others in provision of library services and resources. Similarly, Bradley, (2019:3), and Odeyemi, (2019:1) revealed that, academic libraries in developed world have implemented disruptive technologies such as chatbots, Amazon's Alexa, among others in provision of library services and operations. On the other hand, John, (2020:1) opines that some libraries are using mobile apps to offer library services such access to library catalogue and interactive library guides.

With increased subscription to online research databases and repositories by academic libraries, use of physical books in libraries has decreased significantly. For instance, Okonedo-Adegbaye et al., (2014:2) points out that several academic libraries subscribe to online library databases such as Elsevier, JSTOR, Ebsco-Host, Emerald Publishing, Springer, AGORA, HINARI among others. Additionally, Cooper, (2015:1) noted that, librarians and library users are now searching in online databases for information resources they need since physical books and bound journals have disappeared.

2.4. Required Library Staff Competencies

Equipping library staff with the right skills and competencies as well as offering continued training is key to the effective adoption of disruptive technologies in any sector. As pointed out by Atiso & Adkins, (2015:3), librarians are critical players within the information industry standing between the information creator and the user and they only require the right technologies and skills for optimum library service delivery. During this era of disruptive

technologies, academic library staff require ICTs skills which is key in embracing these technologies. Vlachos et al., (2019:1) found out that, today, some libraries and librarians have embraced the use of robots and artificial intelligence in their library services and operations hence the need to impart new knowledge to their library staff. According Tanloet & Tuamsuk, (2011:239) emphasized the importance of IT competencies among library staff as this will enable them use personal computers (PC), printers, photocopiers, audio-visual materials an among other ICT facilities made available by the library. similarly, Toyese et al., (2018:7) opined that library staff ICT competency will enable them use ICT tools made available to them for information selection and acquisition, organization and storage, retrieval, and dissemination. Therefore, as emphasized by Musangi, (2015:1), reference librarians in academic libraries cannot stay static or traditional in their services or out of reach to users, they need to harness technology in order to meet user needs.

However, although there is a desire to have competent library and information professionals who can exploit the benefits of the available disruptive technologies, several factors and challenges hinder skills development. Mwelwa et al., (2020:4) pointed out that skills and educational programmes in data science and engineering and data management in the broadest sense are fundamental to the effective exploitation of the digital revolution.

2.5. Requisite ICT Infrastructure for Adoption of Disruptive Technologies

Adequate ICT infrastructure supported by adequate internet connectivity and electricity will ensure effective adoption of disruptive technologies in libraries. As stated by International Telecommunications Union, (2018:104), disruptive technologies such as IoT, AI, BDA and blockchain solutions among others thrive well when they are supported by a cloud computing infrastructure. In developing world, and as stated by Ndung'u & Signè, (2020:7), this can be achieved by encouraging governments of these developing countries to accelerate the physical connectivity of fiber-optic networks which will help in upgrading technology on the continent thus lowering unit costs of internet hence help libraries subscribe to higher bandwidth.

To reap full benefits of the available disruptive technologies, academic libraries must be ready to put in place conducive digital environments supported by adequate ICT infrastructure. For instance, Breeding, (2016:1) opines that for a library to adequately offer remote library services

using disruptive technologies, it requires an ICT infrastructure that supports workflow automation, self-service, resource sharing, among other services otherwise, a weak, or obsolete technology will impede success of the library service. Therefore, poor ICT infrastructure in a library will definitely affect the utilization of the available disruptive technologies by 21st library users.

2.6. Ideal Library Environment for Adoption of Disruptive Technologies

According to (Liah & Priti, 2019:4), learners, researchers and general library users have attained 21st century information seeking skills and their information seeking patterns have drastically changed due to the influence of technology. Therefore, as stated by Breeding, (2016:1), libraries should adopt technologies that align well with their strategies, resonate with their patrons, and facilitate the work of their staff. Additionally, libraries should remain abreast of the current modern technology infrastructures such as cloud computing infrastructure as suggested by International Telecommunications Union, (2018:104) which is a key enabler for adoption of disruptive technologies such as IoT, AI, BDA and blockchain solutions among others. Therefore, in order for a library to succeed in its journey of achieving digital maturity and reap full benefits of disruptive technologies, it should put in place conducive digital environments supported by adequate ICT infrastructure and other resources. According to Barb et al., (2018:2) companies and institutions are likely to benefit by making digital systems and infrastructure a priority, upskill existing talent with digital skills, replacing manual processes with digital and driving innovations with digital at the core.

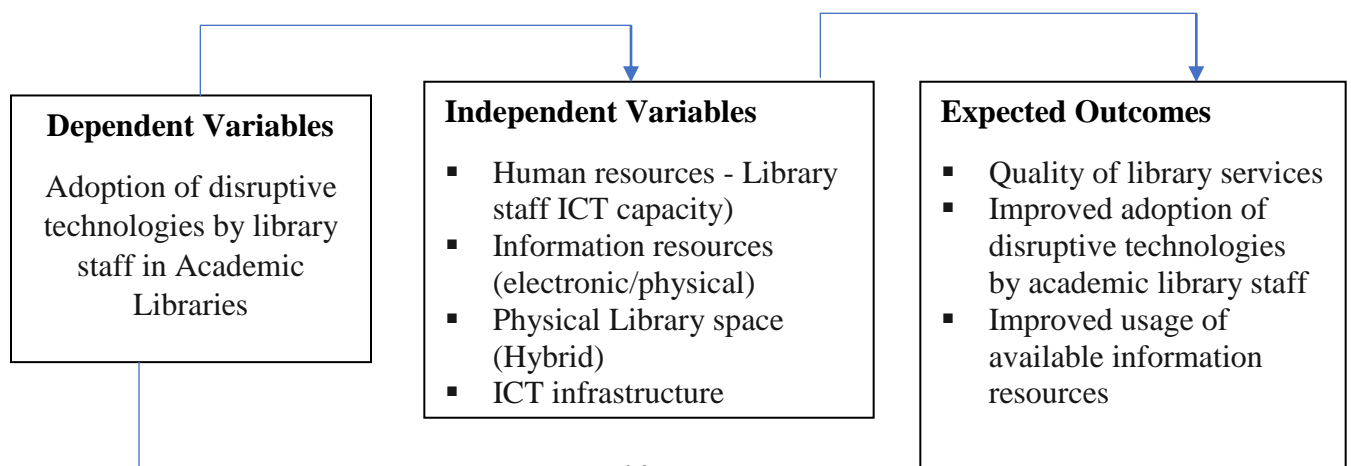
2.7. Conceptual Framework

A conceptual framework for this study was derived from the Service Innovation Model (SIM) developed by Yeh and Ramirez in 2016. Through this model, it was noted that the critical and cardinal resources that enable service innovation in any library are skills, knowledge, space, alliances, and digital technologies (Yeh & Ramirez, 2016:4). As noted by Bullinger et al., (2003), the above resources follow a six-step nonlinear process namely, idea generation, requirements analysis, concept development, implementation, launch, and post-launch review as shown on **Figure 2** below.



Figure 2: Conceptual Model of Service Innovation (Yeh & Ramirez, 2016:4).

Using this model as its diagrammatically illustrated in **Figure 2** above, the researcher came up with a conceptual framework below **Figure 3** which shows the relationships between the different variables.



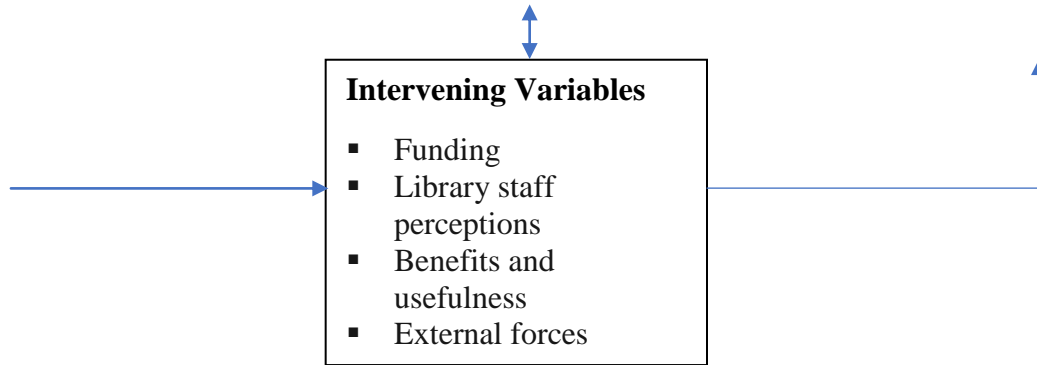


Figure 3: Conceptual Framework (Researcher, 2021)

Adoption of disruptive technologies by staff in academic libraries is dependent on the human resources (library staff ICT capacities), physical library space (hybrid), ICT infrastructure and the information resources (electronic and physical). However, in an ideal situation, all these are targeted on achieving improved service delivery. In addition, for quality information services, library staff perceptions and finances are needed, hence becoming the intervening variable.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

3.0. Introduction

This chapter discusses the research methodology and design applied in this study. The discussion includes, research design, area of study, target population, sampling strategies and techniques, data collection instruments, validity and reliability of the instruments, data analysis, and ethical issues.

3.1. Research Design

As defined by Creswell (2014:296), research designs are types of inquiry within qualitative, quantitative, and mixed methods approaches that provide specific direction for procedures in a research study. This study applied qualitative research approach and interview guides were used to collect data. In qualitative research, research methods are centered on the how and the why of a particular issue, process or situation (Dworkin, 2012:1).

Therefore, using this approach, data and information related to adoption of disruptive technologies in academic libraries was collected from a professional and management point of view of the library staff working at Mahatma Gandhi Graduate Research library, University of Nairobi library management and ICT staff who directly serve in this library.

3.2. Area of Study

The study was carried out at Mahatma Gandhi Graduate Research library, University of Nairobi – Kenya and was limited to assessing the level of adoption of disruptive technologies by library staff in that library. The choice of the Mahatma Gandhi Graduate Research library was influenced by two key factors: firstly, the library serves one of the oldest, largest, and most prestigious public chartered universities in the county with a history dating back to 1961. Secondly, the library enjoys a robust and fairly established ICT infrastructure, which is a critical component for a successful adoption of innovative technologies by academic libraries in any country.

3.3. Target Population

Mugenda and Mugenda (2012:245) defines population as a set of all the elements, units, objects, or subjects in the universe of interest for a particular study. In this study, target population consisted of library staff working at Mahatma Gandhi Graduate Research library, the University of Nairobi library management and the ICT staff who directly serve this library. Library staff were selected because they are proactively involved in the implementation, adoption, and utilization of technologies, hence were better placed to provide crucial and adequate information related to adoption of disruptive technologies in this academic library.

The University of Nairobi management staff were selected because they are involved in the decision making in the University of Nairobi library system hence would provide crucial information regarding strategic decisions on adoption of disruptive technologies in the library. The ICT staff were selected because adoption of disruptive technologies require adequate ICT infrastructure hence the focus on these ICT staff as they provided important information on the state of ICT infrastructure that can support adoption of disruptive technologies.

3.4. Sampling Strategies and Techniques

3.4.1. Sampling Strategies

This study applied non-probability sampling method on the target population. Library staff at MGGRL were selected since they are all expected to be engaged in provision of information services and therefore using the available disruptive technologies in the process. The ICT staff were selected because they are involved in managing and supporting the ICT infrastructure which hosts the Mahatma Gandhi Graduate Research library information systems and software. University of Nairobi library management was also selected because they provide comprehensive strategic directions and decisions to guide the University of Nairobi library.

3.4.2. Sample Size

Pandey & Pandey (2015:40), defines sampling as selecting a given number of subjects from a defined population as representative of that population. For this study, qualitative research method was applied in selecting the sample size. As noted by Dworkin (2012:1) sample size used in qualitative research methods is often smaller than that used in quantitative research methods.

In this regard, this study purposely selected eleven (11) respondents according to their administrative and operational positions at MGGRL and university of Nairobi library management. They consisted of five (5) library staff working at Mahatma Gandhi Graduate Research library, four (4) University of Nairobi library management staff and two (2) ICT staff who directly serve Mahatma Gandhi Graduate Research library. It's important to note that, although eleven were selected to participate in the interviews, only nine (9) participated and responded to the interview questions. The two not interviewed were not available due to unavoidable circumstances.

3.4.3. Sampling Techniques

In this study, purposive sampling technique was applied by the researcher to select the respondents to participate in this study. This technique was used because of the small number of library staff based at Mahatma Gandhi Graduate Research library, University of Nairobi library management as well as the ICT staff serving the university library. respondents were purposively sampled depending on their administrative and operational positions as it relates to adoption of disruptive technologies at this library -MGGRL.

3.5. Data Collection Instruments

3.5.1. Interview Guides

Three categories of interview guides were designed and used to collect data from the respondents. These categories included: one interview guide for the library staff based at Mahatma Gandhi Graduate Research library, another one for University of Nairobi library system management staff and a third for the ICT staff who directly serve the Mahatma Gandhi Graduate Research library. By categorizing the interview guides, the researcher was able to identify questions requiring response from the different respondents used and this enabled the research to contact open-ended interviews.

Due to covid -19 epidemic which prevented physical meetings, the researcher administered the interview guides through the use of phone calls and online teleconferences with the respondents. In addition, efforts were made to secure prior appointment with the targeted respondents for the interview as well as sharing the interview questions earlier with respondents in order to prepare them and avoid any inconvenience and delay during the interview. With permission from the respondents, the researcher recorded the interview using a mobile phone recorder for future reference during data analysis for this study.

3.5.2. Document Review

In this study, documents examined included University of Nairobi library policy documents such as ICT policy among others, which showed that the university library has adopted information and communication technologies (ICTs) in its endeavors to provide quality library and information services. In addition, other documents consulted included he researcher also browsed the university library website and social media pages to collect more information related to adoption of ICTs in this library.

3.6. Research Instruments

3.6.1. Pilot Study

The designed interview guides were subjected to checks by academic library staff, information professional peers and experts in the area of study in order to test and assess their validity and reliability as data collection tools. Due to covid -19 restrictions, testing was done at Kenyatta University post-modern library. A sample size of two library assistant staff and one senior librarian based at Kenyatta University post-modern library participated in the exercise and were

excluded in the actual study. The data collected was analyzed and used to fine tune the interview guide by giving feedback on its efficiency. Possible corrections were made before administering the tool for actual research.

3.6.2. Validity

Guided by the study objectives and research questions, interview guides were drawn. To check validity of the interview guides as a data collection tool, the researcher engaged the study supervisors, library and information professional peers and experts in this area of study. Their observations and suggestions were used in designing interview guides that was adopted for data collection in this study.

3.6.3. Reliability

Pandey & Pandey, (2015:21) defines reliability as consistency throughout a series of measurements. To test reliability of the interview guides, the researcher worked closely with the study supervisors, library and information professional peers and experts in the area of study especially those based at Kenyatta university post-modern library who were very helpful in the pre-testing.

3.7. Data Analysis, Interpretation, and Discussion

This study applied qualitative research approach to analyze and interpret contents of the qualitative data collected through interview guides. Content analysis was preferred because it is suitable and appropriate for the analysis of open-ended interview questions which helped the researcher to group responses in the right categories or themes. The primary data collected on level of adoption of disruptive technologies in academic libraries in Kenya was carefully studied and helped the researcher to generate the themes and categories of the study. Data collected through interview guides was checked for consistency, accuracy and uniformity as well as edited for completeness and consistency. Secondary data collected from document reviews was also reviewed and analyzed. As part of the conclusions, recommendations were made, and areas of further research suggested.

3.8. Ethical Considerations

The researcher obtained a letter of introduction and authorization from the University of Nairobi. This letter was to assure respondents that any information shared will be handled with a high

degree of confidentiality and only used for academic and learning purposes. The researcher also obtained a research permit authorizing the study from the Kenya National Commission for Science Technology and Innovation. All respondents were requested to voluntarily participate in study without any form of reward either in monetary or in kind. All information sources were acknowledged in order to ensure intellectual integrity and avoid any forms of plagiarism as well as abuse of copyright.

3.9. Chapter Summary

This chapter provided important information and knowledge on research methodology used and related aspects used in conducting this study. Further, this chapter highlighted issues regarding research design, area of study, target population, sample size, sampling techniques, data collection method, validity, and reliability, as well as ways of data analysis and presentation. The chapter also considered ethical issues that included confidentiality and plagiarism.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.0. Introduction

This chapter presents, analyzes, interprets, and discusses the data collected from the respondents based on study objectives and research questions.

4.1. Study Respondents

As shown earlier in chapter three, the study applied qualitative approach to collect data from the targeted population. Nine respondents comprising of five (5) library staff of the Mahatma Gandhi

Graduate Research Library, two (2) University of Nairobi library management staff and two (2) ICT staff participated in the interviews. Due to the COVID-19 pandemic, it was not possible to carry out face-to-face interviews as the library staff worked on strict shifts with restrictions on physical visits to the library building. The nine respondents were interviewed through telephone calls and video conference. Questions were triangulated across the four sets of interview schedules to check and collect varied views on disruptive technologies utilized at Mahatma Gandhi Graduate Research Library. Triangulation also helped on checking on biasedness. The findings are reported in the following sections as per the study objectives.

4.2. Disruptive Technologies and their use at Mahatma Gandhi Library

On disruptive technologies already adopted at Mahatma Gandhi Graduate Research Library. Most respondents interviewed stated that,

“...this library has adopted a hybrid and smart library system that employs many disruptive technologies for the general management of library services and resources”.

Several respondents gave an elaborate explanation about the library automation systems and its use by mentioning that,

“Vubis Smart is a library automation system adopted at Mahatma Gandhi Graduate Research Library and is used to manage library functions including cataloguing, the Online Public Access Catalogue (OPAC), circulation, referencing and as well as generating related administrative reports”

Other technologies mentioned by respondents included,

“....barcode and barcode readers and RFID technology support safeguarding the security of library materials; the library also employs Turnitin for plagiarism checking; use Zotero for managing research citations; self-checking system; a smart 3M gate system for entry and exit check; DSpace for development and management of the Institutional Repository (IR); use of social media tools such as YouTube, Twitter & Facebook were mainly used for uploading user guide & library videos. CCTV has been installed for overall security management”.

These study findings correlates with a study by Wilders, (2017:1) who observed that, most academic libraries have transformed into open shelf environments which have replaced some of the manual library services operations. Some academic libraries have started using systems such as book self-check systems, biometric systems, institutional repositories, electronic acquisitions, online cataloguing, online circulation, OPAC systems, e-journals and e-books are now common. Additionally, Makori, (2017:4) revealed that most academic libraries in Kenya utilize ICTs to offer various dynamic information resources and services to their library users. Similarly, Odeyemi, (2019:5) established that most Nigerian academic institutions and their libraries offer online information resources and services to their patrons.

4.3. Library Staff Perceptions Towards Disruptive Technologies at MGGRL.

On the library staff perception towards adoption of disruptive technologies at Mahatma Gandhi Graduate library, most respondents mentioned that library staff have a positive perception towards disruptive technologies. For instance, three library staff based at Mahatma Gandhi Graduate Research Library observed that,

“ ... my perception ... is positive because they have eliminated the manual work such as frequent shelving of books by library staff. Adoption of VUBIS Smart system has eliminated manual cataloguing, circulation among other manual library services ”.

An ICT staff directly serving this library also mentioned that.

Disruptive technologies adopted at Mahatma Gandhi Graduate Research Library have eliminated manual work associated with user services because of the use of self-service machines for library users; these disruptive technologies have enabled adoption of remote access to library resources by library users; It has made it easy for library staff to offer library services to users; and that by embracing ICT in their professional careers, the library staff can easily work in electronic environments.

Another staff mentioned that their perceptions were positive because,

“Library staff can concentrate on other demanding activities because most of the library services can be offered online. Additionally, the benefits of disruptive technologies are enormous. There is increased visibility, networking, collaboration and information sharing... ”.

Some of the above findings are in line with assertions by Atiso & Adkins, (2015:3) who asserted that, librarians are critical players within the information industry standing between the

information creator and the user and they only require the right technologies and skills for optimum library service delivery. Additionally, the findings corresponds with assertions by Bradley, (2019:1) who asserted that adoption of disruptive technologies by libraries helps librarians in their work, reduce manual library operations, support inclusive and accessible library services, promote collaboration among people leading to more information sharing and communication as well as facilitation of new research discoveries.

Positives perceptions by the library staff is a clear indication that modern technologies are proofing to be beneficial to both library staff and library users, however inadequate funding is hampering the utilization of newer disruptive technologies.

4.4. Extent at which Library Staff Use Available Disruptive Technologies at Mahatma Gandhi Graduate Research Library.

On the extent of how library staff interact with the existing disruptive technologies. Data collected reveal that library staff use these technologies or innovations on a daily basis as they carry out their official library duties. An additional question on how library staff use these technologies elicited the following feedback:

One library staff said,

“... we use these technologies on a daily basis to offer library services... to offer training to users; and to access library resources and services remotely”

Another staff added,

“We use the available technologies on a daily basis to carry out library functions like cataloguing, for circulation, for monitoring security through CCTV and for administration especially generation of daily reports”.

From the above findings, it can be deduced that the library staff at Mahatma Gandhi Graduate Research library are using disruptive technologies to carry out library functions and operations such as circulation, reference, self-serve among others. This shows that adoption and use of disruptive technologies is now widespread among academic libraries hence changing the way library services and operations are offered. This corresponds with a study by Cooper, (2015:1) who noted that library industry is within the information management ecosystem that has been disrupted by technological innovations. Makori, (2017:4) also asserted that most academic libraries in Kenya utilize ICTs to offer various dynamic information resources and services to their library users

4.5. Library Staff Competencies on the Use of Disruptive Technologies at Mahatma Gandhi Graduate Research Library.

Adoption and implementation of disruptive technologies in academic libraries largely depends on library staff competencies and skills. Asked about what skills and competencies the staff needed to adopt and manage disruptive technologies, the answers were:

“ICT competency skills, good communication skills interpersonal skills and customer care skills”

From the management perspective, one respondent pointed out that.

“ICT competency skills is one of the qualifications they seek when recruiting library staff at the University library. This is integral in adoption of new disruptive technologies in academic libraries”.

When asked about training offered to library staff and the frequency of those trainings in order to be able to use the available disruptive technologies, the following feedback was obtained.

Three library staff pointed out that they received training on-demand, with one using the phrase ‘*on-going basis*’ and another two also noted ‘*...on-going refresher training lessons*’ in addition to the ‘*on-going training*’. Another staff indicated that there was training offered by new technology suppliers. One added that this training is mostly done in-house. Of the three-library staff who directly interacted with users, all were trained on VUBIS Smart software and Turnitin. Two had training on access to e-resources remotely and Biometric Train the Trainer, while only one mentioned being trained on use Zotero bibliographic citations software in order to offer same training to library users.

Another staff pointed out that,

“Most of the library staff have had several opportunities to attend conferences, workshops/seminars related to library and information sciences within the country and overseas. Some respondents indicated to have benefited from inhouse training offered by their library colleagues who attended conferences or trainings overseas or from information systems vendors where they could not attend. This has helped in information sharing and knowledge transfer among library staff”

In agreement, the Deputy Director Library and Information services - in charge of Administration said that library staff underwent,

‘...on-demand training in case of new technologies; on-going refresher training; and online training on remote access to e-resources’.

From the above findings, it’s clear that ICT competency of library staff is very key in adoption of library technologies. This is in line with views by Toyese et al., (2018:7) who stated that ICT competency of library staff is a measure of their capacity to make appropriate use of ICT tools for information selection and acquisition, organization and storage, retrieval, and dissemination.

Additionally, from the findings, it’s clear that library staff based at Mahatma Gandhi Graduate library have attained the required ICT competencies to utilize disruptive technologies adopted at this library. However, academic library staff need to continue engaging in professional development in order to equip themselves with knowledge on new evolving disruptive technologies which are being used by library users to access information resources. Similarly, this agrees to assertions by Musangi, (2015:1) that reference librarians in academic libraries cannot stay static or traditional in their services or out of reach to users, they need to harness technology and its capabilities in order to provide the information and literacy skills needed today by users. Additionally, this fits well with a statement by Vlachos et al., (2019:1) who stated that, today, some libraries and librarians have embraced the use of robots and artificial intelligence in their library services and operations hence the need to impart this new knowledge to their library staff.

4.6. ICT Infrastructure

For effective adoption of disruptive technologies in any library, availability of adequate ICT infrastructure and support facilities is a very key pre-condition. In the efforts to establish the state of the ICT infrastructure and facilities, three library staff noted that,

“Each library staff is assigned a desktop computer and connected to internet access through Local Area Network (LAN) and Wi-Fi access, other ICT infrastructure facilities include OPAC, electricity, desktop computers at the computer lab, CCTV cameras, Book check system, security check system and barcodes. The availability and use of these ICT facilities is a clear indication of adoption and utilization of disruptive technologies at Mahatma Gandhi Graduate Research library”.

On internet connectivity, one respondent opined that,

“Currently yes but it keeps on being interrupted due to electricity and weak connectivity. The Wi-Fi signal is weak”.

Another respondent added,

“Yes. But sometimes, it is erratic”.

Another respondent noted that,

“Adequate internet and access to Wi-Fi was very important to library staff in order to access and functionality of the other ICT facilities at this library”

Through an additional question, the study sought to establish whether the ICT infrastructure at Mahatma Gandhi Graduate Research Library allowed for interoperability which is a common feature with disruptive technologies.

One library staff noted that,

“This was possible because it had happened before. However, more needs to be investigated to explore the possibility of this interoperability. Current systems and ICT infrastructure at this library need to be upgraded”.

Another staff answered,

“Yes; but I am not sure if it can work with newer disruptive technologies, more financial investment is required to purchase newer software and training of library staff and library users”.

From the above findings, it can be concluded that although Mahatma Gandhi Graduate Research Library has adopted disruptive technologies which library staff use to offer library services, there is a need to improve the existing ICT infrastructure at the library in order to be able to support newer disruptive technologies that are emerging in the library and information fields. For any library to adequately adopt most of these newer disruptive technologies, it needs to upgrade to modern networking technology and ensure it has adequate internet connectivity. This corresponds with assertions by the International Telecommunications Union, (2018:104) which asserted that cloud computing infrastructure is a key enabler for disruptive technologies such as IoT, AI, BDA and blockchain solutions among others. Additionally, Breeding, (2016:1) further asserts that, academic libraries require ICT infrastructure that supports workflow automation, self-service, resource sharing, automated statistics on tap, web services such as a recommender service, shared infrastructure as well as fully integrated library back-office functions.

Indeed, for this to be achieved by Mahatma Gandhi Graduate Research Library, funding is one of the major issues appreciated in the adoption and sustainability of disruptive technologies and innovations. This is further discussed in the section below.

4.7. Level of Funding for Adoption of Disruptive Technologies at Mahatma Gandhi Graduate Research Library.

For adoption and implementation of any new technology, financial resources are required. Respondents were asked about the level of funding allocated to adoption of disruptive technologies at Mahatma Gandhi Graduate Research Library. One respondent said,

“Not sure but current technologies are adequately funded as they are still running. However, no upgrades have been made recently and desktop computers at the computer lap have not been replaced yet they are old hence slower”.

Another one added,

“Currently, we have sufficient funding for the already adopted technologies. However, more funding is required to purchase new technologies”.

Yet another one said,

“Not sure how much but we have these technologies running since they were installed. However, I have not seen them being upgraded which points to inadequate funds”

When asked whether the funding allocated to the library by the parent university was adequate, one respondent said,

“The university of Nairobi has taken drastic measures to cut cost and the university library is affected. The University library has to source for funding from other sources such international funding agencies and donors to supplement the limited funding it receives from the university. However, the covid-19 pandemic has affected this avenue”.

From the above findings, it is noted that the respondents seemed to differ on the level of funding to this Mahatma Gandhi Graduate Research Library as most respondents mention that the already adopted technologies have not been upgraded since the time they were adopted. Desktop computers have not been replaced and no new disruptive technologies have been adopted for quite some time which points to inadequate funding. It can be concluded that funding remains a factor that affects other variable in the adoption of disruptive technologies in academic libraries. Inadequate management support by the parent institutions’ management especially on funding to acquire modern technologies is forcing some academic libraries not to adopt these disruptive

technologies which require adequate financial resources to adopt and maintain. This is consistent with a study by Zeleza, (2019:2) which found that, much attention for most universities in African countries focuses on curricula reforms aimed at preparing students holistically for the skills of both today and tomorrow yet give little attention to adoption of fourth industrial revolution technologies in academic libraries for education and knowledge sharing. This inadequate attention and support from the university management leaves academic libraries struggling with many financial challenges which leads them to become irrelevant to their users. Also, as per the research findings above, it can be concluded that budget cuts couple with increased cost of commercial library disruptive technologies or applications as well as subscription fees have strongly affected the adoption of newer disruptive technologies in academic libraries.

4.8. Awareness Program for Library Staff on New Disruptive Technologies.

The study sought to establish how awareness of disruptive technologies was created among the library and ICT staff. A number of channels were mentioned, majority of the respondents mentioned that attending workshops, seminars, and conferences by the staff were the major channels. Other mentioned channels include technology vendors who visit libraries to market their goods and services who share promotional materials like flyers; and benchmarking from similar libraries for example USIU, Kenyatta University and JKUAT libraries. Also, information from colleagues who travel overseas for conferences are a source of information on new technologies. Others are individual effort to identify current trends in the information sector: learning from professional peers: training sessions organized by vendors.

From the above findings, it's clear that there are many awareness channels through which the library staff at Mahatma Gandhi Graduate Research Library are made aware of disruptive technologies available for adoption. This could be either freely available or commercially available applications. However, the channels mentioned above may not provide up to date information on the available disruptive technologies in the market. This correlates with findings by Muriithi et al., (2016:12) who found out that inadequate awareness among library information professionals about the diverse range of disruptive technologies available in the market and the available options is causing more confusion. Therefore, there is a need for adoption of more

approaches in order to ensure the library staff at Mahatma Gandhi Graduate Research library are made aware of the new disruptive technologies.

4.9. Mandate of Library and ICT Staff in the Adoption of Disruptive Technologies

The study sought to establish the mandate of library and ICT staff in the adoption of disruptive technologies at Mahatma Gandhi Graduate Research library. It was established that all the library staff based at the Mahatma Gandhi Graduate Library led by Deputy Director Library and Information services - in charge of technical services are expected to lead in initiating the adoption, access, and utilization of disruptive technologies by the library. They include the systems librarian, senior librarians, ICT support staff and assistant librarians. The different staff cadres had varied responsibilities towards achieving this. For instance, the librarians and assistant librarians based at Mahatma Gandhi Graduate Research Library mentioned that they were mandated to implement the adoption of the technologies; to sensitize other staff and to facilitate technical support. Additionally, they are involved in offering orientation and induction training sessions to new library users as well as training and supporting existing users to log in to the library network to access information resources within the library and remotely.

On the other hand, it was established that the ICT staff were mandated to train the other university library staff on new technologies; offer continued training to the other university staff including academic staff; help users to connect to the library network; and to offer any technical support on a need basis including trouble shooting of the information systems.

The ICT staff also mentioned being mandated to ensure availability of general internet connectivity including Wi-Fi as well as preparing training materials on how to use disruptive technologies adopted at the university of Nairobi library system.

However, when asked on the adequacy of the ICT staff to support adoption of disruptive technologies in the library, one staff observed that,

“...there are only two ICT staff manning the entire University of Nairobi library system. Sometimes, these two are supported by an intern...”

Another staff observed that the ICT support was sometimes erratic probably because the fiber-optic connectivity of the library through KENET has many institutional users.

The above findings reveals that the ICT and library staff directly serving at Mahatma Gandhi Graduate Research Library on adoption of technologies are able to meet their mandate as they

have the required skills and competencies. These findings corresponds to views by Tanloet & Tuamsuk, (2011:239) emphasized the importance of IT competencies among library staff by stating that library staff members should be able to use personal computers (PC), printers, photocopiers, barcode technology, audio-visual materials, e-mail, internet, intranet, library automation, OPAC, web applications, electronic resources, and databases.

From the study findings, it can also be deduced that the ICT section is inadequately staffed, and this affects their work as well as service delivery to library users.

4.10. Policies and Procedures for Adoption of Disruptive Technologies

Policies and procedures of any institution or organization govern or guide the adoption of any new technology. Therefore, the study sought to establish availability of policies or procedures that guide the adoption of disruptive technologies at the Mahatma Gandhi Graduate Research Library. The following polices were mentioned by the respondents:

- University of Nairobi Library Policies and guidelines
- The University ICT Policy
- The University of Nairobi Open Access Policy
- The University's Knowledge Management Policy of the University of Nairobi
- The University's Copyright and Intellectual Property Rights
- Ethical Standards Policy
- The Staff Training Policy

In addition to the above policies, another respondent said that,

“The university of Nairobi also considers any other ICT regulations by the government of Kenya to ensure they are compliant”.

The above finding proof that Mahatma Gandhi Graduate Research Library has put in place adequate policies that touch on adoption of technologies. Additionally, there is an acknowledgement that these policies are aligned with ICT regulations by the government of Kenya.

4.11. Challenges Encountered by Library Staff in Adoption of Disruptive Technologies at Mahatma Gandhi Graduate Research Library.

The study sought to establish whether there were any challenges, and the respondents listed many challenges they encounter as they use disruptive technologies in the library. These challenges include the following:

- Software and hardware obsolescence including non-replacement of old computers
- Inadequate funding that is hampering acquisition of new technologies or to upgrade available ones
- Inadequate computers at the computer lab
- Inadequate infrastructure support due to inadequate ICT technical support
- Loss of data
- CCTV camera failures
- Frequent upgrades of some technologies by innovators/vendors leading to many available options that consequently causes confusion on which ones to adopt
- Predatory applications or software
- Cybercrime threats
- Erratic Internet connection
- Poor Wi-Fi signal
- Unreliable power supply
- Electronic resources are expensive to the university library
- Not able to support staff to attend international conferences like IFLA to learn more or even for benchmarking activities
- Inadequate support for the library by management whose attention is on other priorities

The above challenges are listed according to the frequency of their mention by the different respondents. Of importance to note is that software and hardware obsolescence including non-replacement of old computers, inadequate funding that is hampering acquisition of new technologies or to upgrade available ones comes as the major challenge. This corresponds with a study by Muriithi et al., (2016:4) who established that the effects of technological disruptions, financial recess, inadequate ICT infrastructure, inadequate skills, and continuous budget cuts to academic libraries in most developing countries is exacerbating the existing challenges faced by

academic libraries. Additionally, Mwelwa et al., (2020:4) asserted that inadequate infrastructure, including slow and unstable connectivity, unreliable power supply, obsolete computing infrastructure from medium-scale server infrastructures to small numbers of workstations, and lack of centralized and secure data storage are some of the challenges or factors that hinder adoption of newer technologies in many fields.

4.12. Possible Solutions or Suggestions on Managing these Challenges

Respondents were asked to suggest possible solutions to the challenges faced by library staff in adoption of disruptive technologies. Respondents mentioned the following,

- Allocation of adequate financial resources to purchase adequate ICT resource to support adoption of new technologies and improve existing ones
- Install power back-up such as UPS and adequate generators for power supply
- Carry out more benchmarking activities overseas for more information on which technologies to adopt or not
- Advocate for more support from the management
- The university library is a member of the KLISC, and this has helped with subscription to e-resources
- A request has been made to the university management to employ more ICT staff, i.e., one ICT staff for each branch of the University of Nairobi library system / sufficient ICT support
- Adopt adequate cybercrime prevention measures
- Engage IT experts to review the best applications to adopt
- Encourage library staff and library users to bring their own laptops/devices to use the library
- Ensure adequate Internet connectivity and strong Wi-Fi signal
- Upgrade/replace outdated software
- Install adequate and working CCTV cameras
- Provide more computers in the computer labs

The findings as captured in their frequency as mentioned by the respondents concluded that the library would maximize and utilize disruptive technologies if adequate funding is provided but

the library also needs the full support of the parent university management. It can also be concluded that if all the above suggestions are adopted, the library shall provide quality library services to the users.

4.13. Strategies Put in Place to Enhance Sustainability of the Disruptive Technologies

The study sought to establish whether University of Nairobi library management had put in place strategies that will enhance sustainability of the disruptive technologies currently in use and the following was mentioned by respondents,

- There are plans to offer more training to library staff
- Planning to increase Internet connectivity and Wi-Fi
- Still sourcing for more financial resources to support the existing ICT infrastructure.

Although there was no documentation that was provided to proof the above plans, it's worth noting that if implemented, they will go a long way in ensuring there is sustainability of the already adopted technologies. More funding and training, retraining will also be needed as the library grows.

4.14. Other Disruptive Technologies that were Suggested for Adoption

- Cloud computing for secure data storage
- Artificial Intelligence
- Robots – Explore the possibility of using robots to search shelves for books as well as re-shelving hence reduce workload to the staff
- LED Technology
- TV Signage/Display bulletins for displaying new arrivals, announcements
- RFID should be rolled out to all branch libraries of the University library system
- Chat boxes
- Utilize all modules of the VUBIS Smart software
- Include alert notification module to alert library staff if someone borrows a book or returns.

From the above list, it can be concluded that the library lacks the requisite technologies needed in the modern knowledge society.

4.15. Chapter Summary

This chapter highlights the research findings of the data analyzed based on the study objectives and research questions. Qualitative approach was used to guide the analysis of data collected through interview schedules as a data collection tool. The findings are as a result of interpretation of the data collected from the respondents based at Mahatma Gandhi Graduate Research Library, ICT staff serving this library and the University of Nairobi library system management.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0. Introduction

This chapter presents a summary of research findings, conclusions, recommendations, and suggestions for further research on this topic.

5.1. Summary of Research Findings

The aim of the study was to assess the level of adoption of disruptive technologies in academic libraries in Kenya with particular reference to the Mahatma Gandhi Graduate Research Library, University of Nairobi, Kenya. The study was guided by the following objectives which were to: establish the library staff perceptions on the use of available disruptive technologies at MGGRL; establish the extent of adoption of disruptive technologies at MGGRL; find out the capacities of library staff in the use disruptive technologies; examine the ICT infrastructure supporting adoption of disruptive technologies at MGGRL; propose appropriate strategies for the adoption and utilization of disruptive technologies in academic libraries in Kenya. Data was collected using interview schedules and research findings were as discussed below.

5.2.1. Library Staff Perceptions Towards Disruptive Technologies

the study sought to establish library staff perceptions towards disruptive technologies adopted at Mahatma Gandhi Graduate Research Library. According to the research findings, all respondents are aware and recognized that Mahatma Gandhi Graduate Research Library has adopted technological innovations which has been fully supported by the University of Nairobi library Management. Research findings also reveal that library staff perception on these technologies adopted at Mahatma Gandhi Graduate Research Library was positive as the benefits and advantages to this library were enormous. Respondents appreciated the significance of these technologies to their work and the relevance of these technologies to library users of this particular library who require quick access to the most recent research articles and e-resources.

The study findings also illustrated that Mahatma Gandhi Graduate Research Library can use disruptive technologies to:

- 1) Replace traditional manual processes such as card catalogues, manual reference services, manual cataloguing among other manual services hence improve service delivery.

- 2) Create collaboration and information resource sharing between library staff working in different academic libraries located in different locations globally.
- 3) Connect library staff with their library users online.
- 4) Establishes other channels such as social to promote library information resources and services offered at this library.
- 5) Create awareness on the access and use of electronic information resources,
- 6) Update library users on the new library information materials
- 7) Disseminate and publicize the library upcoming events.
- 8) Enable its library staff and librarians' network with their peers and other information professionals.

5.2.2. Extent of adoption of disruptive technologies at Mahatma Gandhi Graduate Research library.

Study findings reveal that the library is a hybrid library that employs many disruptive technologies for the general management of services and resources. Vubis Smart, a library automation system, that is used to manage library functions including cataloguing, the Online Public Access Catalogue (OPAC), circulation, referencing and as well as generating related administrative reports. The barcode and barcode readers and RFID technology support safeguarding the security of library materials. The library also employs Turnitin for plagiarism checking and users are trained on how to use Zotero for managing research citations. Additionally, the library also has a self-checking system, a smart 3M gate system for entry and exit checks. Other disruptive technologies include DSpace for development and management of the Institutional Repository (IR). It was also established that social media tools including YouTube, Twitter & Facebook were mainly used for uploading user guide & library videos. CCTV has been installed for overall security management.

However, the study findings also reveals that the library does not utilize all the modules of the Vubis library automation system. Also, the library had not adopted the latest or newer disruptive technologies such as robots, cloud computing, among other latest technologies being used in developed countries.

5.2.3 Library staff competencies in the use of disruptive technologies

Study findings showed that all respondents have attained competence in ICT skills and are able to use the disruptive technologies already adopted at Mahatma Gandhi Graduate Research Library. The study reveals that ICT competency skills is one of the qualifications to be recruited as one of the library staff. The study further reveals that all library staff have been trained on the use of these technologies and on-going training sessions have continued to be offered to library staff.

5.2.4 ICT infrastructure

Study findings show that Mahatma Gandhi Graduate Research Library has deployed a basic ICT infrastructure and facilities that support the already existing disruptive technologies. This infrastructure is connected to internet access through Local Area Network (LAN) that is supported by a fiber-optic cable through the KENET which serves most of the universities in Kenya. This library is also connected to university Wi-Fi which helps library staff and library users access the library e-resources within the university and remotely. However, the study reveals that the Wi-Fi signal is sometimes not strong, inadequate exchange points (IXPs) at the library, and unreliable and expensive electricity supply remain as major challenges hindering adequate adoption of these disruptive technologies.

5.2.5 Other suggested disruptive technologies

Other technologies suggested by library staff include.

- Cloud computing for secure data storage
- Artificial Intelligence
- Robots – Explore the possibility of using robots to search shelves for books as well as re-shelving hence reduce workload to the staff
- LED Technology
- TV Signage/Display bulletins for displaying new arrivals, announcements
- RFID should be rolled out to all branch libraries of the University library system
- Chatboxes
- Utilize all modules of the VUBIS Smart software
- Include alert notification module to alert library staff if someone borrows a book or returns

5.3. Conclusions

There is a growing interest as well as investments in the adoption of disruptive technologies across academic libraries in developing countries. Reviewed literature and data collected from this study provides a foundation for informed policy making among academic libraries and their management to adequately allocate resources to increase innovations in these libraries which will significantly improve service delivery. This study reveals that library staff perception on the use of these technologies is positive, and they appreciate the significance of these technologies to their work and the relevance of these technologies to library users. They perceive these technologies to promote academic library services, increase library visibility, connect library staff with their patrons, collaboration, resource sharing and library staff networking with their peers in the profession.

The study also showed that Mahatma Gandhi Graduate Research Library has adopted technological innovations that are being used by library staff. However, the study findings also reveals that the library has not been utilizing all the modules of the Vubis library automation system. Also, most of the other adopted technologies have not been upgraded or changed since the time they were adopted at the library.

Additionally, the study found out that the library has deployed basic ICT infrastructure to support the technologies adopted. However, more financial resources are required to upgrade the ICT infrastructure, internet connectivity and other ICT related facilities in order to support adoption new disruptive technologies which are more beneficial to the library staff and library users whose needs keep on changing.

The study further established that library staff at this library have the required ICT competencies and skills to utilize the existing disruptive technologies. Similarly, the study established that all library staff irrespective of their position have received training on the disruptive technologies already adopted at this library.

The study established that the library staff were aware of the issues or challenges they face in utilization of these disruptive technologies at this library and what needs to be done to overcome some of these challenges.

5.4. Recommendations

From the study findings and conclusion, the following recommendations are made:

5.4.1. Allocate adequate financial resources

In order to ensure there is adequate adoption and use of disruptive technologies by library staff based at Mahatma Gandhi Graduate Research Library, it is recommended that the library should massively increase its financial budgetary allocations towards its ICT infrastructure and facilities such as desktop computers, laptops, Local Area Network (LAN), Wi-Fi signal, institutional repository/digital library storage capacity among others. For this to be successful, the library should seek support from University of Nairobi library system management and parent university management.

5.4.2. Carry out resource mobilization activities

University of Nairobi library management should enhance its resource mobilization activities targeting external funders such as non-governmental organizations and private sector in order to seek more financial resources to fund the adoption of disruptive technologies that will improve service delivery to library users. Also, in order to survive external shocks such as Covid -19, academic libraries in universities should start exploring other avenues for financial resources mobilization such as fundraising from local partners, private sector, and local philanthropists in order to keep the digital transformation alive in these academic libraries. This can be done by preparing project proposals and presenting them to these organizations with the sole purpose of securing grants to implement these disruptive technologies or improving the existing library systems

5.4.3. Upgrade library staff capacities in the use of the available disruptive technologies

Globally, most academic library staff are now using new technologies to share information resources and services, curate, and manage institutional repositories. Therefore, library staff at Mahatma Gandhi Graduate Research library require continuous professional development and research in order to keep on upgrading and updating their skills required for their new roles in the adoption and implementation of new disruptive technologies.

This library should regularly be organizing training seminars or workshops on the different available disruptive technologies for its library staff to become familiar with these different new technologies in the market as well as those already adopted by the library. This is geared towards improving library staff level of competencies in use of these technologies to delivery library services.

Additionally, the University of Nairobi department of library and information sciences should include an additional course on library disruptive technologies or library digital transformation in its course curriculum. Teaching about these disruptive technologies will prepare future generations of library and information professionals for the next challenges ahead related to adoption of future disruptive technologies.

5.4.4. Enhance and upgrade ICT infrastructure facilities

Disruptive technologies keep on being updated, re-evaluated and constantly evolving to best provide library services to users. Library staff and professionals as well as ICT staff directly serving this library should continue with their attempts to harness the effects digital transformation brought about by disruptive technologies while designing and implementing any library function and service. the library can achieve this through the adoption and leveraging digital technology brought about by emergence of new disruptive technologies which include:

- Online training platforms
- digital data collection tools and systems
- Digital data sharing applications,
- Cloud-based collaboration
- Online meeting platforms

For this to be achieved, the University of Nairobi library system should ensure there is a robust, reliable, and sustainable internet connectivity as well as a strong Wi-Fi signal which will ensure its library systems are accessible within the university and remotely anywhere anytime by library staff, library users as well as the global research community. Additionally, the University of Nairobi library management should upgrade/replace outdated software as well as utilize all modules of the Vubis Smart library automation system. The library should also install power back-up such as UPS and adequate generators for adequate power supply.

5.4.5. Carry out benchmarking activities

The library should carry out more benchmarking activities within the country and overseas for more information on which library technologies are appropriate to adopt or not. Compare the cost and the existing resources. As the university does benchmarking, it's important to seek the services of IT experts to review the best applications to adopt and advise on cybercrime prevention measures.

Additionally, it's important for the library management to encourage and seek library staff and library user' feedback and participation while carry out these benchmarking activities. This opens doors or interactions and sharing of information between the library management, library staff and library users hence leading to adoption of technologies that better meet user needs.

5.4.6. Sponsor Librarians/library staff and ICT staff to attend conferences

In order to increase awareness of new technologies among library and ICT staff, the University of Nairobi library management should regularly sponsorship librarians/library staff and ICT staff who directly serve the library system to attend international or national conferences such as IFLA or KLA and seminars on ICTs and any other new technologies related to libraries in order to learn or benchmark and keep themselves abreast of these new technologies.

5.4.7. Employ adequate ICT staff to offer adequate ICT support library staff

The University of Nairobi should employ more qualified ICT staff, i.e., one or two ICT staff for each library branch of the University of Nairobi library system in order to provide library staff adequate or sufficient ICT support as well ensuring that cybercrime prevention measures are in place.

5.4.8. Encourage library staff and users to use own devices

Due to increased number of library users who require to use the limited computers at the computer lab, it is recommended that MGGL should encourage its library users to bring their own devices such as laptops and iPads to the library and allow them to connect to the university of Nairobi Wi-Fi in order for them to access e-resources.

Also, its recommended that University of Nairobi library system should embrace remote working and remote library service delivery as the current situation of offering remote library services is likely to be the trend going forward as its not known when the Covid-19 pandemic is going to

end as well as the financial difficulties universities are facing to maintain huge library spaces. The library needs to embrace cloud-based collaboration, online meetings, and training as there is an increased reliance on the web by library staff and library users. This will increase online collaboration and information resources sharing among library staff and library users within the country and globally.

5.5. Suggestion for Further Research

The study was limited to MGGRL at the University of Nairobi, Kenya. However, further study is it's suggested to be carried out in other academic libraries in other university libraries in Kenya. Furthermore, a study needed to be carried out using other research methods such as the mixed research methods (quantitative, qualitative etc.) and include more data collection tools in order to get more in-depth insights on the level of adoption of disruptive technologies by library staff.

Further studies on disruptive technologies related to libraries should not be limited to academic libraries in universities in Kenya but should also include libraries such as public libraries. This is in view of the advancing digital revolution among libraries in Kenya.

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APPENDIXES

Appendix 1: Introduction letter from the University of Nairobi



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DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE

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Our Ref: UON/CHSS/DLIS/303/ C54/10930/2018

Date 26th March 2021

Director General,
National Commission for Science, Technology & Innovation,
P. O. Box 30623-00100, Nairobi.

Dear Sir/Madam,

**RE: RECOMMENDATION FOR NZIOKI, RICHARD NZUKI: REG NO:
C54/10930/2018**

The above named is a bonafide student at the University of Nairobi undertaking a Master of Library and Information Science (MLIS). He is currently in the process of collecting data as part of the requirements for the course.

His topic is *“An assessment of the level of adoption of disruptive technologies by academic libraries in Kenya with reference to Mahatma Gandhi Graduate Research library, University of Nairobi, Kenya.”*

Any assistance accorded to him will highly be appreciated.

Regards,

A handwritten signature in black ink, appearing to be 'DJP'.

Dr. Dorothy Njiraine
Chairperson, Department of Library & Information Science (DLIS)

Appendix 2: Introductory letter to respondents.

Dear Respondent,

I am a student at the University of Nairobi, Kenya pursuing a Masters in Library and Information Science. I am currently undertaking a research project titled: *An assessment of the level of adoption of disruptive technologies by academic libraries in Kenya with reference to Mahatma Gandhi Graduate Research library, University of Nairobi, Kenya.*”

I hereby request for your voluntary participation in the study. Your anonymity is assured, and you are therefore requested not to write/type your name anywhere on the data collection tool. Any information shared shall be handled with a high degree of confidentiality and only used for this research project.

For any other clarification about this research, please contact me on rnzuki@students.uonbi.ac.ke and [+254723567781](tel:+254723567781).

Thank you,

A handwritten signature in black ink, appearing to read 'Richard Nzuki', written over a horizontal line.

Nzioki, Richard Nzuki,

C54/10930/2018

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

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Appendix 4: Interview Schedule for the University of Nairobi Library Management staff

I am a student at the University of Nairobi, Kenya pursuing a Masters in Library and Information Science. I am currently undertaking a research project titled: *An assessment of the level of adoption of disruptive technologies by academic libraries in Kenya with reference to Mahatma Gandhi Graduate Research library, University of Nairobi*”.

Section A: Demographic Information

1. Gender: Male Female
2. Designation;
3. Section;
4. Email Address;

Section B: Interview questions

- a) What are your perceptions towards adoption and use of disruptive technologies at MGGRL?
- b) To what extent has disruptive technologies been adopted at MGGRL?
- c) Are there any policies or procedures guiding the adoption of disruptive technologies at MGGRL?
- d) What is your mandate towards adoption of disruptive technologies at this library?
- e) What is the level of funding that is allocated to adoption of disruptive technologies at Mahatma Gandhi Graduate Research library?
- f) What approaches have been put in place in ensure equitable adoption, access, and use of disruptive technologies by library staff at Mahatma Gandhi Graduate Research library?
- g) Have library staff been trained to keep up with disruptive technologies trends?
 - If Yes to the above question, what training did you receive?
 - If No to the above question, why?
- 1) What are the library staff competencies in adoption and utilization of disruptive technologies?
- h) What is the level of funding allocated to library staff training or attend conferences on disruptive technologies?
- i) What is the frequency of training of library staff on disruptive technologies at MGGRL?

- j) Have you established awareness programme for library staff on new disruptive technologies?
- k) Have you appointed any specific library staff to facilitate adoption, access and utilization of disruptive technologies at MGGRL?
- l) If yes to above question, which library staff are responsible for managing and sustaining access and utilization of disruptive technologies at MGGRL?
- m) What challenges do the University of Nairobi library management encounter in the adoption of disruptive technologies at MGGRL?
 - How do you manage these challenges?
- n) What strategies have been put in place to enhance sustainability of the available disruptive technologies at MGGRL?

Appendix 5: Interview Schedule for the MGGRL Staff.

I am a student at the University of Nairobi, Kenya pursuing a Masters in Library and Information Science. I am currently undertaking a research project titled: *An assessment of the level of adoption of disruptive technologies by academic libraries in Kenya with reference to Mahatma Gandhi Graduate Research library, University of Nairobi*”.

Section A: Demographic Information

1. Gender: Male Female
2. Designation;
3. Section;
4. Email Address;

Section B: Interview questions

- a) What are your perceptions towards adoption and use of disruptive technologies at MGGRL?
- b) To what extent has disruptive technologies been adopted at MGGRL?
- c) To what extent are library staff able to use the available disruptive technologies at MGGRL?
- d) Have you received any training on any disruptive technologies available at MGGRL in the last one or two years?
 - If **Yes** to the above question, what training did you receive?
 - If **No** to the above question, are there reasons?
- e) What is the frequency of trainings offered to library staff on available disruptive technologies?
- f) Are there any policies or procedures guiding the adoption of disruptive technologies at MGGRL?
- g) What is your mandate towards adoption of disruptive technologies at MGGRL?
- h) Are there any specific library staff appointed to facilitate adoption, access and utilization of disruptive technologies at MGGRL?
- i) If yes to above question, who are the library staff responsible for adoption of disruptive technologies at MGGRL?

- j)** What is the level of funding that is allocated to adoption of disruptive technologies at MGGRL?
- k)** How do library staff become awareness of new disruptive technologies?
- l)** To what extent does the ICT infrastructure team support the adoption of disruptive technologies at MGGRL?
- m)** What challenges do the library staff encounter in the adoption of disruptive technologies at MGGRL?
 - How do you manage these challenges?
- n)** Apart from the current disruptive technologies that have been adopted and utilized at MGGRL, which other disruptive technologies can you recommend for this University library and for what library services can they be used?

Appendix 6: Interview Schedule for the ICT infrastructure staff.

I am a student at the University of Nairobi, Kenya pursuing a Masters in Library and Information Science. I am currently undertaking a research project titled: *An assessment of the level of adoption of disruptive technologies by academic libraries in Kenya with reference to Mahatma Gandhi Graduate Research library, University of Nairobi*”.

Section A: Demographic Information

1. Gender: Male Female
2. Designation;
3. Section;
4. Email Address;

Section B: Interview questions

- a) What are your perceptions towards adoption of disruptive technologies at MGGRL?
- b) To what extent has disruptive technologies been adopted at MGGRL y?
- c) What is the level of funding that is allocated to ICT Infrastructure support at MGGRL?
- d) What is ICT infrastructure team’s mandate on adoption of disruptive technologies at MGGRL?
- e) Have you appointed any specific ICT infrastructure staff to support adoption, maintenance, access, and utilization of disruptive technologies at Mahatma Gandhi Graduate Research library?
- f) Are there any polices or procedures guiding the ICT infrastructure team in the adoption of disruptive technologies at MGGRL?
- g) Is the ICT infrastructure adequate to support adoption of disruptive technologies at MGGRL?
- h) Is physical ICT infrastructure at MGGRL connected to fiber-optic networks?
- i) Does your ICT infrastructure at MGGRL allow interoperability with virtual platforms?
- j) Is there adequate internet service provision to support adoption of disruptive technologies at MGGRL?

- k) What is the frequency of ICT Infrastructure trainings offered to ICT staff?
- l) Have you received any training on any disruptive technologies available at Mahatma Gandhi Graduate Research library in the last one or two years?
- If Yes to the above question, what training did you receive?
 - If No to the above question, why?
- m) Is there an awareness programme for ICT infrastructure staff on new library disruptive technologies?
- n) What challenges do the ICT staff encounter in the adoption of disruptive technologies at Mahatma Gandhi Graduate Research library?
- How do you manage these challenges?
- o) Apart from the current disruptive technologies that have been adopted and utilized at Mahatma Gandhi Graduate Research library, which other disruptive technologies can you recommend for this University library and how can they be used?

Appendix 7: Budget required (in Kenya shillings)

An assessment of the level of adoption of disruptive technologies by academic libraries in Kenya with reference to Mahatma Gandhi Graduate Research library, University of Nairobi, Kenya.”

Item	Cost
Transport and Incidentals	Ksh. 30,000
Laptop	Kshs. 30,000
Contingencies for obtaining permits/certification and professional experts	Kshs. 10,000
Stationery, Printing and Binding	Kshs. 5,000
Internet services	Kshs. 10,000
Total	Kshs. 85,000

Appendix 8: Timeline

An assessment of the level of adoption of disruptive technologies by academic libraries in Kenya with reference to Mahatma Gandhi Graduate Research library, University of Nairobi.”.

The project will take a period of 20 weeks

Date/week	Activity
1 st January 2021 – 30 th March 2021=12 weeks	Proposal writing, defense, and approval
15 th April 2021 – 30 June 2021=10 weeks	Data collection and Data analysis
1 st July 2021 – 31 st December 2021=24 weeks	Report writing, presentation and dissemination